A CLIMATIC STUDY: LEXINGTON, KENTUCKY

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Lexington, administrative center of Fayette County, is located 80 miles south of Cincinnati, 75 miles southeast of Louisville and 55 miles northeast of the geographic center of the state. It is situated in the heart of the Bluegrass region and lies at an elevation of approximately 1,000 feet above sea level. The surface of the county is mildly karst and gently rolling with a maximum relief of 200 feet. Eastward the relief becomes more pronounced and at a distance of 50 miles the westward-facing edge of the Cumberland Plateau is reached.

The Bluegrass region was one of several sections west of the Appalachians settled and developed at an early date. The first settlers came mainly by way of the Wilderness Trail which ran through the Cumberland Gap. Interest was directed not only to the excellent forests, fertile soils, and choice crop lands, but to the region's climate as well. Some of the climatic records for Lexington date back to 1828. The early records, however, were fragmentary and were not continuous.

Professor Thomas J. Mathews of Transylvania University, Lexington, Kentucky, kept the records during the year of 1828 and part of 1829. In the years 1835–1838, Dr. L. P. Gandell and Dr. Robert Peter, both of Transylvania University, made observations of temperature, rainfall, and barometric pressure. A report was made to the College of Physicians and Surgeons and an article appeared in the *Transylvania Journal of Medicine*, entitled "Notices of the Weather and Diseases of 1835." No further records are available until the year of 1858 and from that date to the present, records are complete with the exception of the years 1876–1879 inclusive. Beginning with the year 1858 records were kept by Mr. H. F. Hillenmeyer of the Hillenmeyer Nurseries, located three miles north of Lexington. These records have been continued by Mr. Hillenmeyer's sons, Ernest, Louis, and Walter, throughout the years.

In 1872 the Signal Corps of the United States Army opened a weather observatory at State College, later known as the University of Kentucky, but no information is available to explain the reasons for this office being closed between 1876–1879. Beginning with the summer of 1879 and continuing through 1887 their records were kept at the Hillenmeyer Nursery. In 1887 an office was re-established by the Signal Corps in downtown Lexington, but within a year was moved back to the College grounds. The reasons for the removal are not clearly set forth in the records, but in contemporary reports it appears that the press gave little encouragement to the publication of the forecasts and reports, and only a jealousy toward Louisville made sufficient excuse locally for the maintenance of the observatory. A desire by the Experiment Station for records in connection with its agricultural activities seems to be given as one argument for connecting the service with the College. The collecting of climatic data was under the direction of Professor V. E. Munsey for a period of 10 years, but late in 1898 the work was once more undertaken by a regular Weather Bureau official at the expense of the government. As the College grew to the capacity of a University, the Weather Bureau office was increased in equipment and personnel to meet any demands that the University might make of it in an educational way. During the summer of 1906, Mr. C. H. Noyes was placed in charge of the observatory with the rank of Local Forecaster.

In the summer of 1915 the location of the observatory was again changed to a downtown office occasioned by a rising demand on the part of business for the services of the Weather Bureau, a demand which seemed to overshadow the university requirements. Mr. George B. Wurtz became the official in charge and

continued in this capacity until his retirement in 1933. Mrs. E. S. Kinkead took over the work at this time and continued to keep the records until 1944 when the office was transferred to its present location at the Bluegrass Airport, 5 miles west of Lexington, under the direction of the United States Weather Bureau.

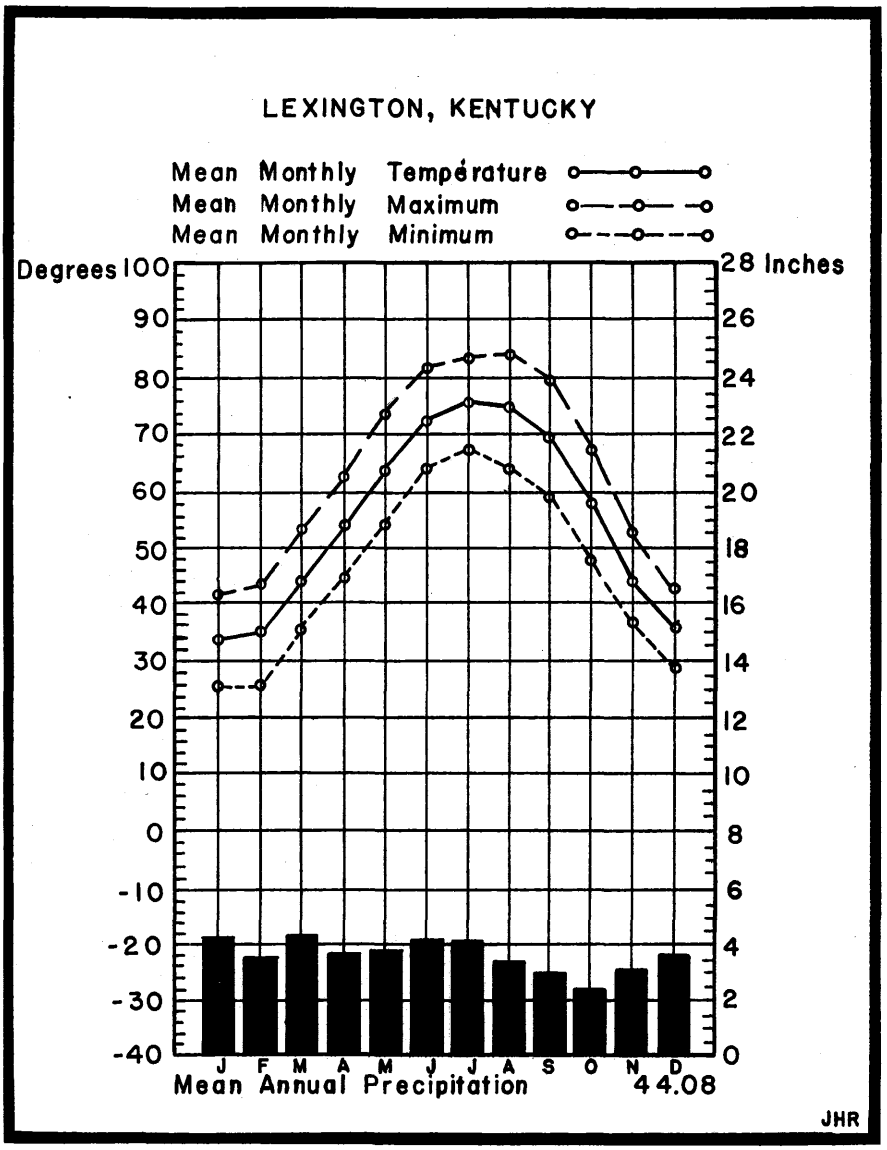

FIGURE 1

Lexington and eastern Kentucky lie within or near the path of moisture bearing cyclonic storms which move from the Gulf region, northeastward over the Mississippi and Ohio Valley regions. Convectional activity which varies greatly in frequency, character, and force is another factor in the summer weather of this region.

Table I and Fig. 1 present a summary of various precipitation and temperature data. The mean monthly precipitation varies from a maximum of 4.33 inches in March to a minimum of 2.45 inches in October. The mean annual precipitation is 44.08 inches. Almost 23 inches of this total, or a little over one-half, falls during the colder half of the year (November to April inclusive). The distribution of precipitation during the seasons is as follows: spring,[1] 11.88 inches; summer, 11.85 inches; autumn, 8.67 inches; and winter, 11.68 inches. This shows that the spring, summer, and winter seasons receive nearly a quarter more precipitation than the autumn months.

TABLE I

PRECIPITATION AND TEMPERATURE AT LEXINGTON: AVERAGES AND EXTREMES
(Length of Record 62 Years)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Average precipitation	4.27	3.68	4.33	3.75	3.80	4.21	4.15	3.49	3.01	2.45	3.21	3.73	44.08
Average number of days with 0.01 inch or more precipitation	14	12	13	12	12	12	11	10	8	8	10	12	134
Average temperature	33.7	34.9	43.9	53.9	64.1	72.9	76.2	74.8	69.5	57.3	44.7	35.8	55.1
Average of the maximum temperature	41.6	43.1	53.1	63.6	73.8	82.5	84.1	84.3	79.4	67.3	53.2	43.3	64.2
Average of the minimum temperature	20.6	26.7	34.7	44.0	54.3	63.4	66.6	63.7	59.3	47.4	36.2	28.4	46.0
Absolute maximum temperature	80	75	86	91	96	104	108	102	101	93	80	71	108
Absolute minimum temperature	—15	—20	—1	15	30	40	47	46	32	21	—3	—9	—20
Highest monthly average temperature	50.9	53.4	65.0	71.7	83.4	91.2	94.0	95.0	90.6	75.7	62.3	58.4	68.8
Lowest monthly average temperature	12.0	15.6	27.6	36.9	47.7	59.3	63.3	61.4	52.3	40.4	29.5	17.5	43.1

TABLE II

DRIEST AND WETTEST MONTHS AND YEAR OF OCCURRENCE AT LEXINGTON

	Driest Month	Year	Wettest Month	Year	Normal
January	0.77	1931	15.10	1937	4.27
February	0.52	1895	11.06	1883	3.68
March	0.46	1910	9.91	1890	4.33
April	0.40	1896	7.36	1872	3.75
May	0.65	1932	11.03	1882	3.80
June	1.05	1864	10.62	1928	4.20
July	0.45	1930	11.24	1875	4.14
August	0.62	1875	8.96	1932	3.48
September	0.33	1895	8.63	1868	3.01
October	0.11	1924	7.95	1919	2.45
November	0.53	1904	8.50	1919	3.21
December	0.80	1925	9.02	1865	3.73
Annual	24.89	1930	65.76	1935	44.08

Table II shows that the difference between the driest and wettest months of record is considerable. The precipitation for the wettest months has varied as

[1] In this paper March, April, and May may be considered as being the spring months; June, July, and August, the summer months; September, October, and November, the autumn months; and December, January, and February, the winter months.

much as 10 to 70 times the minimum with the greatest difference occurring in October (Fig. 2). October, 1924, was the driest month on record with 0.11 inch and January, 1937, the wettest, with 15.10 inches. Each of the months has received less than an inch of precipitation at least once with the exception of June which has had a minimum of 1.05 inches. The difference between the driest year, 1930, with 24.89 inches, and the wettest year, 1935, with 65.76 inches, is greater than 40 inches. This shows a marked contrast within a period of five years.

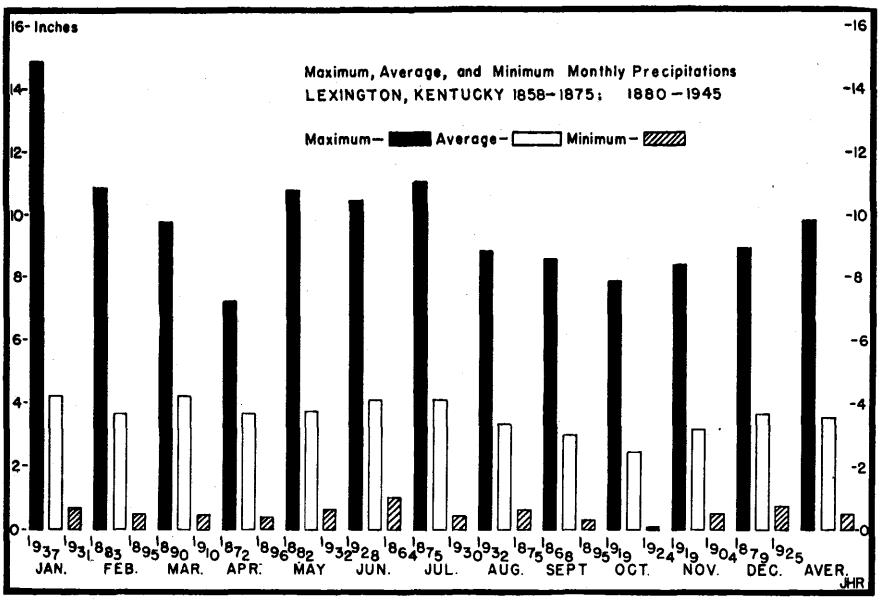

FIGURE 2

Table III shows the late summer and autumn months to be dry more often than the other months of the year. It also shows the same period of the year to have had a lower percentage of months with 5 inches or more of precipitation.

TABLE III

PERCENTAGES OF ALL MONTHS ON RECORD AT LEXINGTON

	Receiving 1.5 inches or less	Receiving 5 inches or more
January	4.8	28.6
February	7.1	17.9
March	6.0	38.1
April	8.3	22.6
May	8.3	25.0
June	3.6	26.2
July	8.3	31.0
August	14.3	20.2
September	17.9	13.1
October	28.6	10.7
November	13.1	17.9
December	3.6	26.2

During the record of 62 years 28% of the Octobers, for instance, had 1.5 inches of precipitation or less but only about 10% of them had 5 inches or more.

The rainfall at Lexington is so well distributed that long periods of continuous wet or dry conditions do not exist without interruptions. Occasionally there is too much rain, especially during the spring months; droughty conditions sometimes prevail in late summer or autumn, but timely rains often occur relieving the situation sufficiently to prevent serious disaster to the principal crops.

The monthly and annual precipitation for an 84-year record, 1858–1945 with the exception of the years 1876–1879 inclusive, has been examined with a few very interesting observations. During this period the annual precipitation exceeded the average of 44.08 inches 40 times, or 47.6% of the time, while it dropped under the average 44 times, or 52.4% of the time. The graph (Fig. 3) showing the departure from normal reveals this fact clearly. The annual rainfall in 72% of the years has been over 40 inches, while 18% of the years it has been in excess of 50 inches; in 6% of the years over 60 inches was received. There were only two years in which the total precipitation fell below 30 inches.

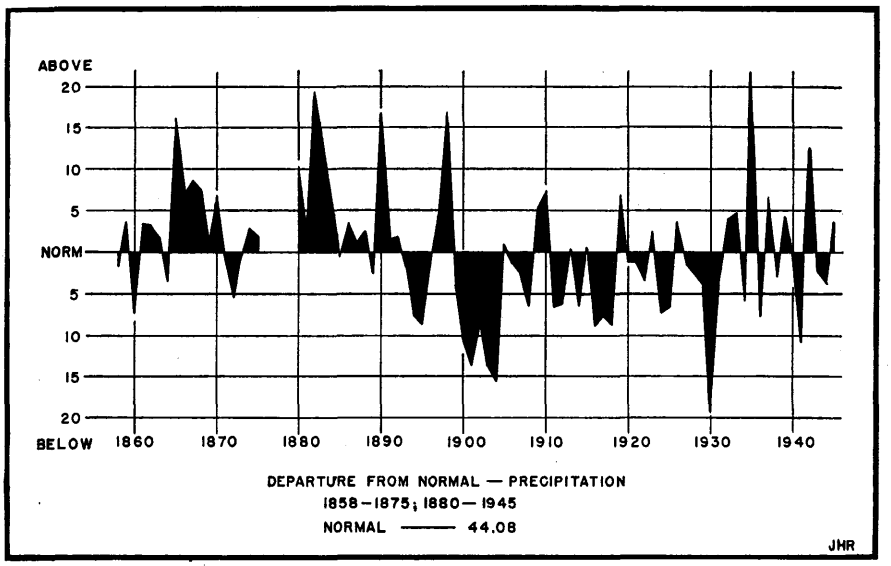

FIGURE 3

The monthly totals of precipitation of one inch or less (a very dry condition) have occurred the following number of times in the 84-year period: January, 1; February, 4; March, 2; April, 3; May, 3; June, 0; July, 5; August, 2; September, 9; October, 17; November, 4; December, 1. As previously shown, October is the driest month with an average of 2.45 inches, but this data reveals that a very dry October occurs 20% of the time or an average of once in five years. The other months of the year, with the exception of September, are very dry only on rare occasions, about 3% of the time, or an average of once in 34 years.

Monthly totals for precipitation of more than twice the expected or average amount have occurred the following number of times at Lexington during the 84-year period: January, 6; February, 9; March, 1; April, 0; May, 4; June, 2; July, 5; August, 7; September, 4; October, 9; November, 4; December, 3. April is the only month in which the precipitation did not double the average amount expected at any time. January, February, August, and October more than doubled the expected on 31 occasions or for a total of 58% of the 54 times that it was doubled. Monthly rainfall totals in excess of 10 inches have occurred 9 times, twice in each of January, May, June, and July and only once in February. The greatest monthly total of 15.10 inches occurred in January, 1937.

Table IV presents data on temperature and precipitation at Lexington over a 62-year period as indicated. Although there are many periods in which rains of an intensity of .01 inch or more fell each day for five or six consecutive days, the longest period on official record is for 11 days. This took place on two different occasions, May 3 to May 23, 1892, and again from August 12 to August 22, 1901. The Hillenmeyer records, somewhat contradictory to this, indicate that rain fell every day during the month of August, 1906; and during the following month of September the sun failed to break through the clouds and there was a trace or more of rain nearly every day. Precipitation of .01 inch or more averages about 134 days each year.

Floods are not unknown in Lexington and neighboring areas, and periods of heavy precipitation have been recorded on different occasions. The most serious flood in Lexington's history took place on August 2, 1932, when more than eight inches of rain fell in 12 hours and Main Street became a turbulent river. On June 28–29, 1928, 5.50 inches fell during the two consecutive days, and on September 3, 1922, 4.12 inches fell in a little over three hours or a total of 5.45 inches for the day. A much earlier record, July 10–12, 1875, reveals a fall of 5.64 inches in an interval of 72 hours. The Hillenmeyer records also show an uninterrupted

TABLE IV

GREATEST NUMBER OF CONSECUTIVE DAYS

(1873–1876, 1888–1945)

Maximum 100° F. or above, 9 days, from July 7 to July 15, 1936.
Maximum 90° F. or above, 21 days, from August 8 to August 28, 1936; also from July 23 to August 12, 1941.
Minimum 32° F. or below, 43 days, from December 25, 1917, to February 5, 1918.
Minimum 20° F. or below, 19 days, from January 3 to January 21, 1893.
Minimum 10° F. or below, 14 days, from January 20 to February 2, 1936.
Minimum 0° F. or below, 7 days, from February 8 to February 14, 1899.
Precipitation .01 inch or more, 11 days, May 3 to May 23, 1892; also August 12 to August 22, 1901.
Precipitation less than .01 inch, 26 days, October 5 to October 30, 1924.

rain of four days duration, September 27–30, 1887, with a total fall of 3.65 inches. Their records also give what is probably a record rainfall for a 30-minute period in Kentucky for on August 16, 1900, a fall of 2.24 inches was recorded in 30 minutes.

Dry periods in which little or no rain is received over periods of 12 to 15 days occur rather regularly in late summer. As a rule it is too late in the season to damage the crops, and in many cases may even be considered beneficial as it aids in the ripening processes. The longest period of consecutive days in which less than .01 inch of precipitation fell occurred between October 5 and October 30, 1924, a period of 26 days. During the year 1930, central Kentucky experienced its worst drought. April and July were extremely dry, all spring and summer months being drier than usual and an annual precipitation of 24.89 inches, the lightest in the history of Lexington.

Records of snowfall for Lexington have been tabulated for all months of the year excepting June, July, August, and September. Traces have been observed as late as May 25 (1925), and as early as October 19 (1930). Snowfall in May and October, however, averages less than a day for each month with a maximum average of five days for January. The average number of days with snowfall is 18 per year distributed as follows: October, –; November, 1; December, 4; January, 5; February, 4; March, 3; April, 1; May, –. The latest heavy snowfall ever recorded in Lexington fell on May 20, 1894, on which date a six-inch snowfall blanketed the city and surrounding country; a killing frost caused serious damage to garden and field crops.

The longest period that snow, with a depth of 1.0 inch or more, has lain on the ground continuously is for 26 days, from January 12 to February 6, 1918. The

maximum snowfall for any single storm occurred between January 13 and 15, 1917, when a total fall of 16.1 inches was recorded; both highway and railway traffic were blocked. The thawing of this snow caused a washout of the gas line serving Lexington and as a result many homes were without heating facilities. On January 26, 1943, 13.4 inches of snow fell during the day which is the heaviest recorded fall within such a period.

Thunderstorms have been recorded for every month of the year, although the maximum intensity occurs in mid-summer. In winter they are usually associated with the cold front of a cyclone while those of summer may be either of the same type or convectional. Probably the most extensive mid-winter electrical storm took place on January 31, 1917, and was accompanied by much thunder. The average monthly distribution of thunderstorms is as follows: January, 1; February, 1; March, 2; April, 4; May, 6; June, 8; July, 9; August, 7; September, 4; October, 1; November, 1; December, 1. There is an average of 45 days a year with thunderstorms, the three summer months having 54% of the total.

Although hail occurs infrequently at Lexington, it does at times result in slight damage to local crops. While no month of the year is immune, November is usually regarded as being less likely to have hail. Some years may experience none whatsoever. The largest hail ever seen in Fayette County fell on May 21, 1917, when stones having a diameter of three and one-quarter inches were reported.

The mean annual temperature at Lexington is 55.1° F. (See Table I), and the mean monthly temperatures range from 33.7° F. in January to 76.2° F. in July, a total of 42.5°F. The absolute range in temperature is from a low of −20°F to a high of 108°F, a total of 128°F. Other temperature data may be observed from a study of Tables I and IV. The range of temperature is great as might be expected from the continental location of Lexington. The city also has a large amount of sunshine during the summer months which often results in high daily and monthly temperatures.

Temperatures of 100° F. or over are rather rare; some summers pass without experiencing it. The highest temperature ever recorded was a reading of 108° F. on July 10 and July 15, 1936. In this same year there were nine consecutive days with a temperature of 100° F. or over, from July 7 to July 15. Temperatures of 100° F. or over, however, have occurred as early as June 27 (1936), and as late as September 14 (1936 and 1939). Between the years 1888 and 1945 only 10 years had recorded temperatures of 100° F. or over, an average of one year in every six. Interesting to note, six of these 10 years with 100° F. or over have occurred between 1934 and 1945 inclusive, during a 12-year period, while the other four were spread between the years 1888 and 1933 inclusive, over a 46-year period. Lexington has had 35 days with a temperature of 100° F. or over during this 58-year period. Four of the 35 days occurred before 1934 and 31 that year and later.

Further study reveals that all years have had temperatures of 90° F. or over: 90° F. readings have been noted as early as April and as late as October; 80° F. readings as early as March and as late as November; and 70° F. readings at some time in every month of the year. The greatest number of consecutive days with a temperature of 90° F. or over has been 21 and was recorded on two different occasions, from August 8 to August 28, 1936, and again in 1941 from July 23 to August 12.

Tables IV and V present minimum temperature data. Subzero temperatures have not been experienced every year, but over the recorded period they have occurred 34·of the 62 years or approximately an average of one year in every two. There have been only 128 days with a temperature of 0° F. or lower, an average of two days every year. Only 17 of the 128 days have experienced a temperature of −10° F. or lower.

The lowest temperature officially recorded in Lexington has been −20° F. on February 13, 1899, and the next lowest −17° F. on February 10 of the same year.

Various unofficial readings from parts of central Kentucky report lower readings, one being −27° F. for February 13. It was the coldest day of a week during which the temperature was below 0° F. every day. Official readings for the week were: February 8, − 4° F.; February 9, −15° F.; February 10, −17° F.; February 11, −4° F.; February 12, −12° F.; February 13, −20° F.; February 14, −1° F. The Kentucky River, solidly frozen, was passable for team and wagon. The latest date with a temperature of below 0.° F. was March 4 (1873) with a reading of −1° F. The earliest date was November 29 (1929) with a reading of 0° F., followed by −3° F. the next day.

It is interesting to note that 28 of the 34 years with 0° F. or below occurred between the years 1888–1933, the same period that only four years had tem-

TABLE V

MINIMUM TEMPERATURE DATA

A—Number of Days Considered
B—Number of Days with indicated Minimum
C—Percentage of Total

	Jan.	Feb.	Mar.	Apr.	May	Sept.	Oct.	Nov.	Dec.
32°F OR BELOW									
A	1922	1751	1922	1860	1922	1860	1922	1860	1922
B	1380	1207	857	224	3	1	107	675	1227
C	71.2	68.9	44.6	12.0	.16	.05	5.6	36.3	69.2
20°F OR BELOW									
A	1922	1751	1922	1860	.....	.....	.....	1860	1922
B	524	498	161	5	.....	.....	.....	93	424
C	27.3	28.4	8.4	.27	.....	.....	.....	5.0	22.1
10°F OR BELOW									
A	1922	1751	1922	.....	.....	.....	.....	1860	1922
B	225	176	23	.....	.....	.....	.....	8	120
C	11.7	10.1	1.2	.....	.....	.....	.....	.43	6.2
0°F OR BELOW									
A	1922	1751	1922	.....	.....	.....	.....	1860	1922
B	62	41	1	.....	.....	.....	.....	2	22
C	3.2	2.3	.05	.....	.....	.....	.....	.11	1.1

peratures of 100° F. or over. In the interval, 1934–1945 inclusive, a temperature of 0° F. or lower was recorded in six of the years. As has been shown previously, this was the time when maximum readings of 100° F. or over had been observed six years out of a total of ten during the 58-year period considered. This would seem to indicate that there has been a slight shift from cooler to warmer conditions, however, the time period is too short for any definite conclusions.

Table V, Minimum Temperature Data, enables one to compare the number of days of a given minimum temperature with the total number of possible days and to observe the percentage of the total. For example, there were 1,922 days in the 62 Januarys considered. Of these, 1,380 days had temperatures of 32°F or below at some time during the day, or a total of 71.2% of all days in January. It will be seen that January is the coldest month with February and December slightly less so. The latest date with a temperature of 32°F occurred on May 20, 1894, and the earliest date occurred on September 30, 1899.

The average length of the frost-free season is 189 days; in four-fifths of the years it is 178 days. The latest last killing frost in spring ever officially recorded was on May 20, 1894, and the earliest first killing frost in the autumn was on September 24, 1928. The last killing frost in spring occurs on the average on April 16 and in the autumn the average date of the first killing frost is October 22. In four-fifths of the years the last killing frost in spring comes about April 23 and the first killing frost in the autumn comes about October 18. The longest frost-free season has been 233 days and this has occurred on two different occasions during the recorded period. In 1902 the frost-free period was from April 8 to November 27, and in 1922 from March 22 to November 10. The shortest frost-free period was 142 days in 1894, from May 20 to October 9.

The relative humidity at noon, local time, reaches an average of 74% in winter, 61% in spring, 58% in summer, and 62% in atumn. The relative humidity at8 a. m. is somewhat higher with values of 82, 76, 78 and 79% respectively.

The average number of days with dense fog is 11 per annum, the greatest number of these occurring in late atumn and the winter months. The months of March, April, May, June, and July average less than a day each; August, September, and October have an average of one each; and November, December, January, and February have an average of two each.

Over a period of 32 years, records show the percentage of possible sunshine to be greater in summer than in winter; 63% in July and August in contrast with only 35% in December. Distribution of possible sunshine by seasons is as follows: winter, 37%; spring, 52%; summer, 62%; autumn, 55%. Summer not only has a greater percentage of possible sunshine but its hours of sunshine is about 60% more than in winter, 15 hours in June as contrasted with 9 hours in December. The summer sunshine is also more intense than that of winter since the altitude of the sun in June is 75° 28′ while in December it is 28° 28′. The number of gram calories of heat per square centimeter of surface in June on a clear day is about 800 while that in December is only 270.

The prevailing wind direction for Lexington is from the southwest throughout each month of the year over a 42-year period. The average wind velocity ranges from 10 to 12 miles per hour, with values somewhat higher during the winter months and reaching a maximum average velocity of 13.2 miles per hour in March. The wind probably reached one of its greatest measured velocities in 1918 when a maximum of 56 miles per hour was recorded. Severe winds associated with tornadoes or tornado-like storms have been recorded on different occasions.

This study does not fully present nor does it attempt to analyze all the phenomena of the weather and climate of Lexington. Such a task is beyond the purpose of this paper. The data selected and method of presentation may be improved upon; however, it is hoped that sufficient material has been assembled which will stimulate others to make similar studies, so that information relative to our weather and climate may be made available to all.